



# Post Shutdown DØ Luminosity

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*February 23, 2005*

- Summary of pre-shutdown status
- Changes in post-shutdown measurement
- New problems
- Action items
- Towards new solutions
- Status

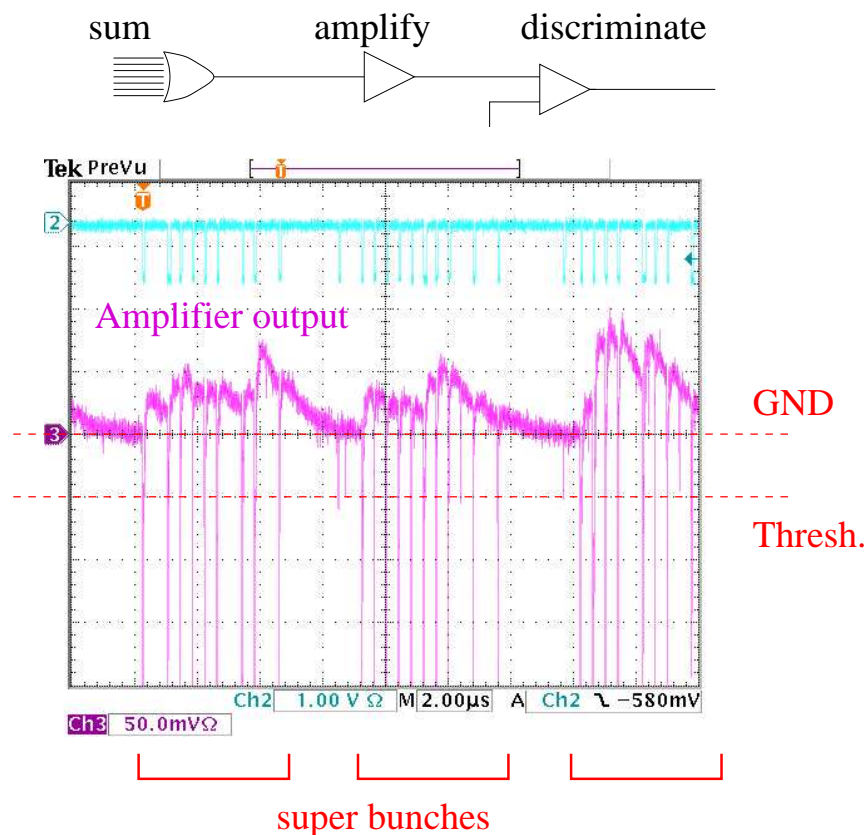


## Pre-shutdown Luminosity

Found large baseline shifts in PMT signals due to AC coupling.

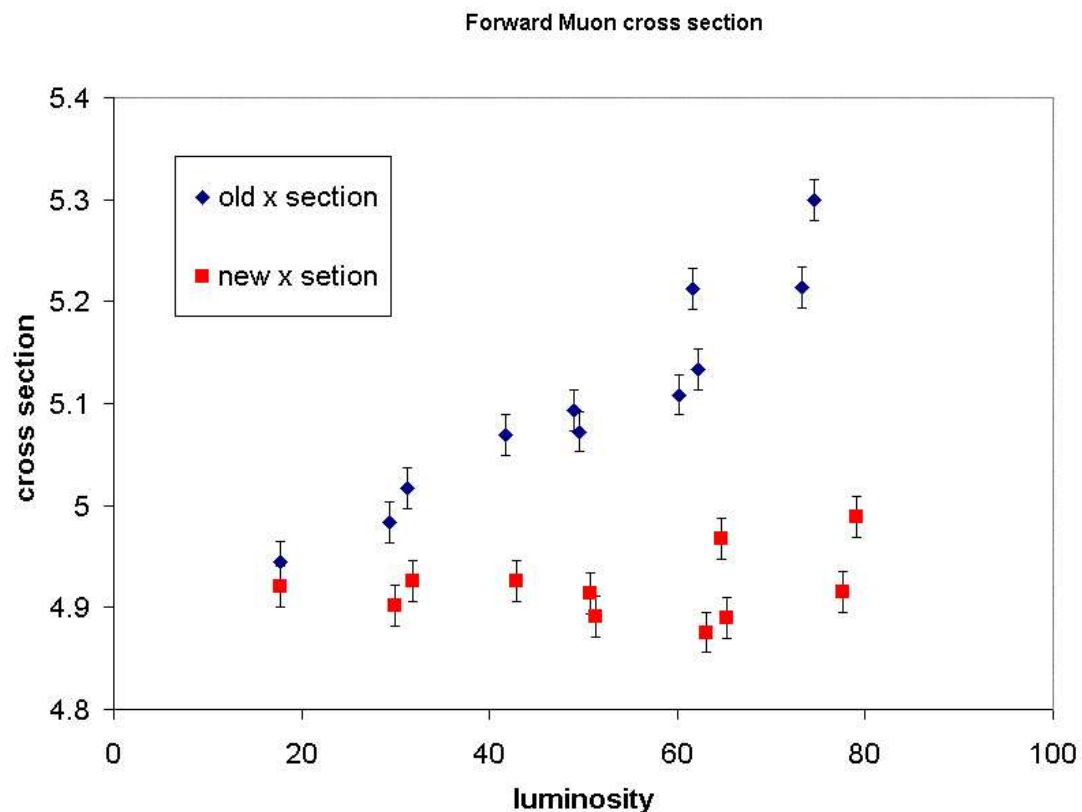
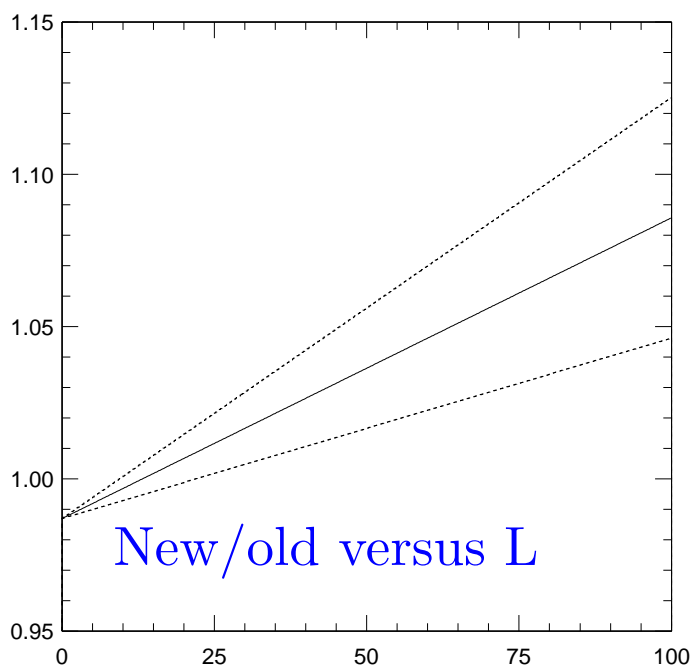
Leads to a quadratic error in luminosity measurement.

parameterized and tested up to about  $50\text{e}30$  with the last few stores before the shutdown.





# Preliminary Correction



Preliminary correction indicated most of the CDF/DØ AC component could be explained by this problem



## Post-shutdown Tests

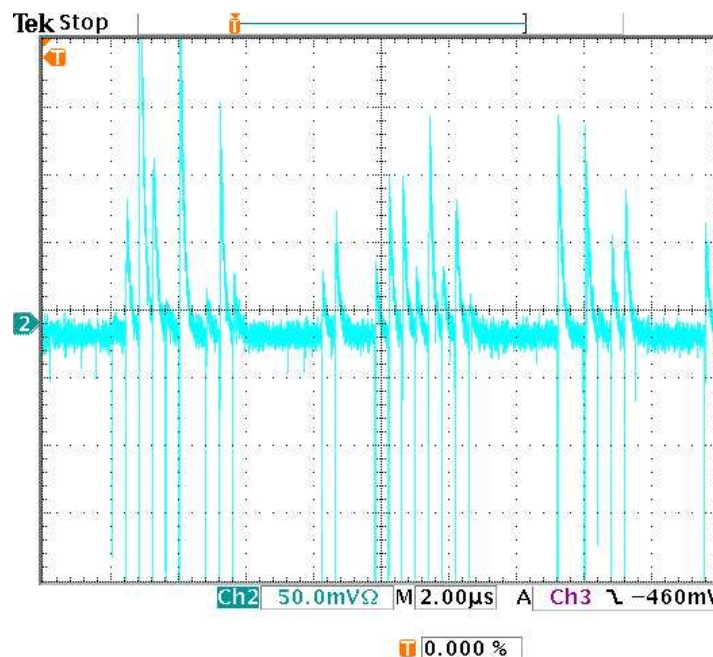
Attempted two fixes:

DC coupling with active baseline restoration

AC coupling with short time constant

tested both with several stores

On Dec. 20th settled with the AC coupling scheme



22 Feb 2005  
10:34:58



## Expected Changes

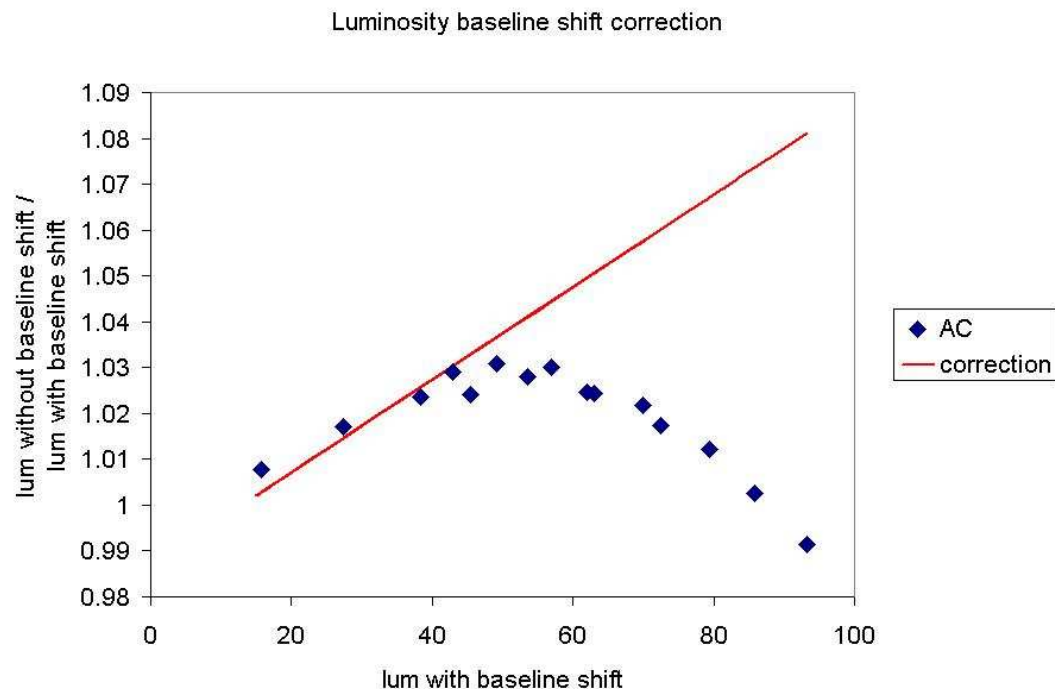
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- different coupling scheme effects measurement at all luminosities  $\Rightarrow$  about 1% increase.
- lower magnetic field  $\Rightarrow$  higher PMT gain  $\Rightarrow$  about 2% increase.
- much more linear due to (almost) eliminating baseline shift
- so overall efficiency shift of about 3%, but linear as a function of luminosity.



## Post-shutdown Tests

In order to map out corrections to previous data sets, replaced new scheme with old scheme several times during a store and measured change in luminosity.



Red line is what we expected.  
Blue points are what we measure.



## Action Items

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Once we realized we still had a problem we came up with the following action items:

- Verify baseline restoration at high luminosities.
- Look for any other problems with the electronics, particularly deadtime in the digital signals.
- Start a comprehensive overview of the entire luminosity calculation:
  - what assumptions are we making? Are they still valid?
  - what are the efficiencies as a function of luminosity?



## FastZ Efficiency

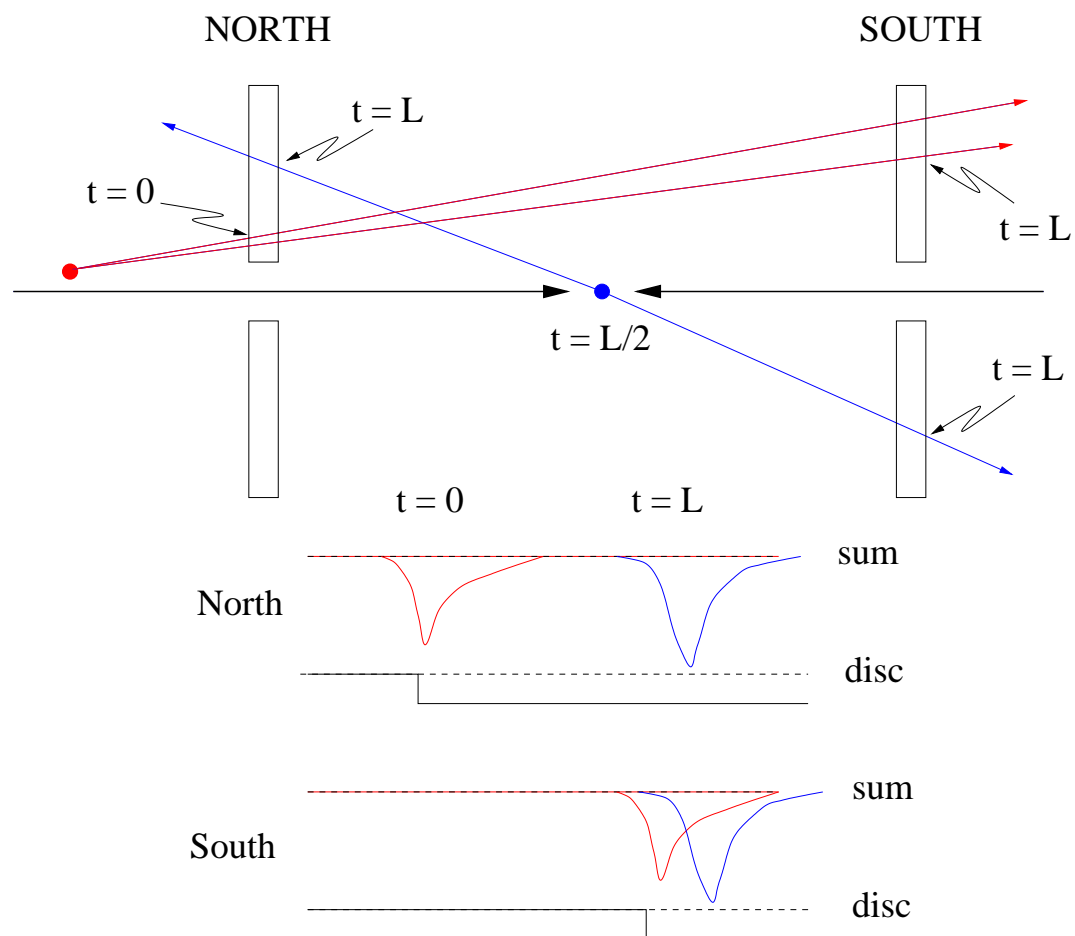
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- Easiest thing to check is the FastZ efficiency.
  - both north and south discriminators fired and the FastZ module reconstructed a vertex within  $\pm 97$  cm.
- looked at triggered events, found a small decrease in FastZ efficiency with luminosity  $\Rightarrow$  leads to a big effect at high luminosities because we counted an extra zero.
- further investigation pointed to a new deadtime due to the discriminators firing early.





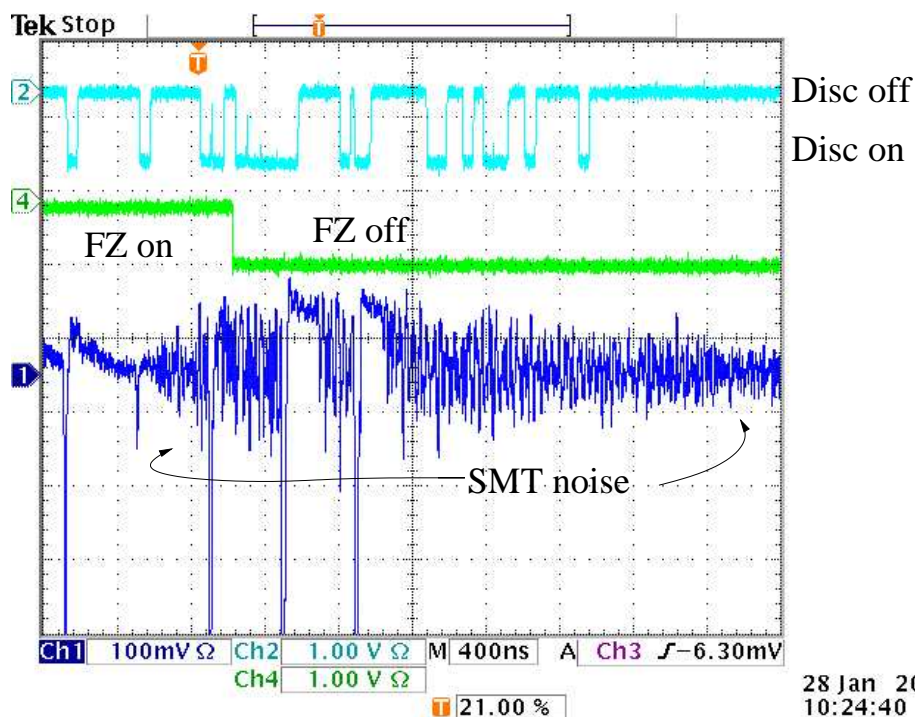
# Discriminator Deadtime from Halo



We have always known about halo deadtime. Online correction in place since last year.

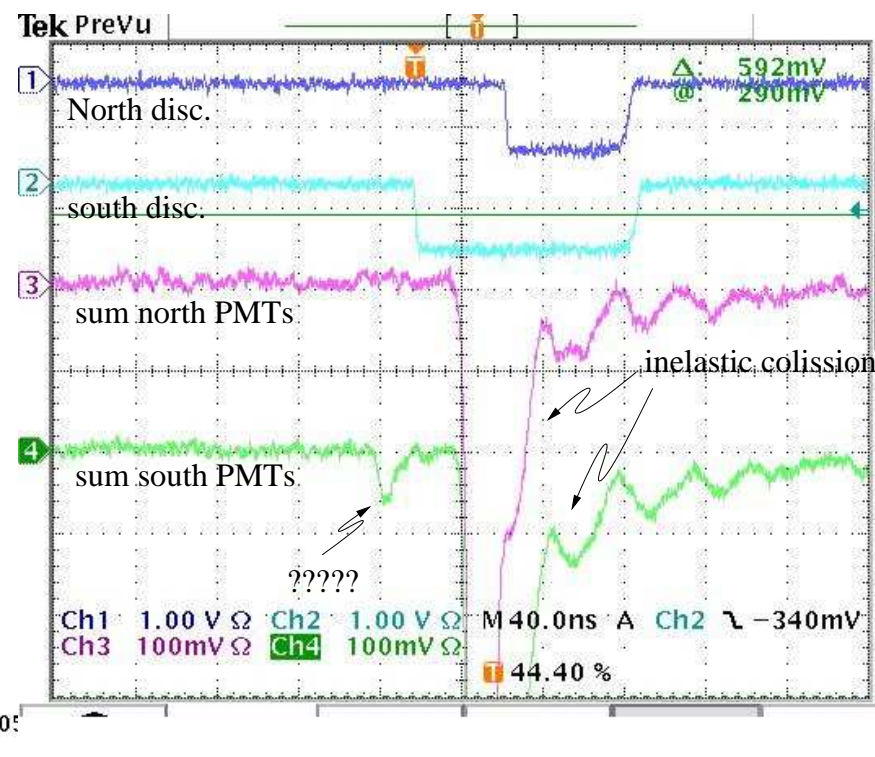


# More Discriminator Deadtime



Bunch train

readout noise



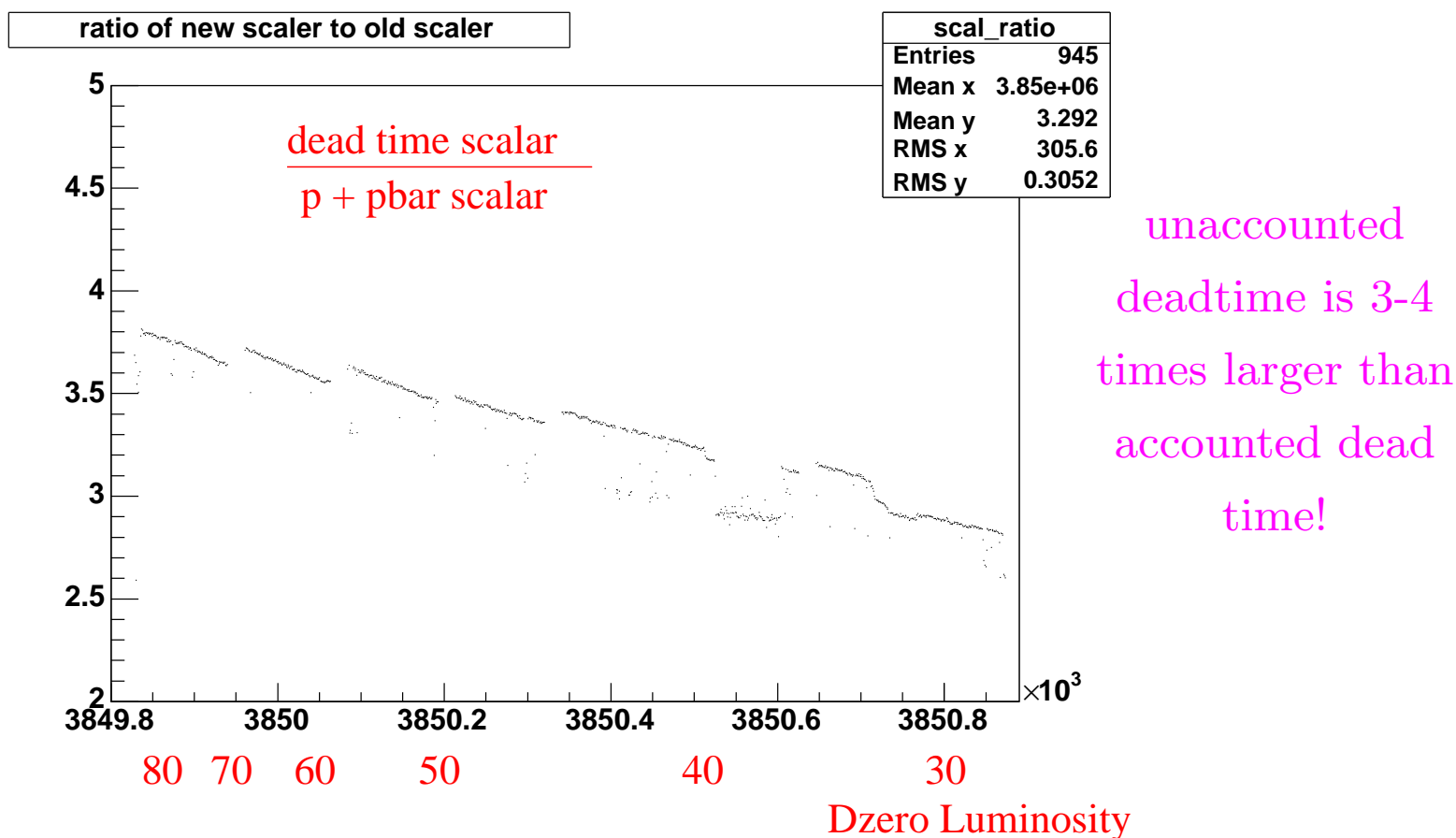
backgrounds not in time with  
the bunch train



# More Discriminator Deadtime

created a new scalar that counts crossings where both north and south discriminators fire and a good vertex is not found.

Store 3956



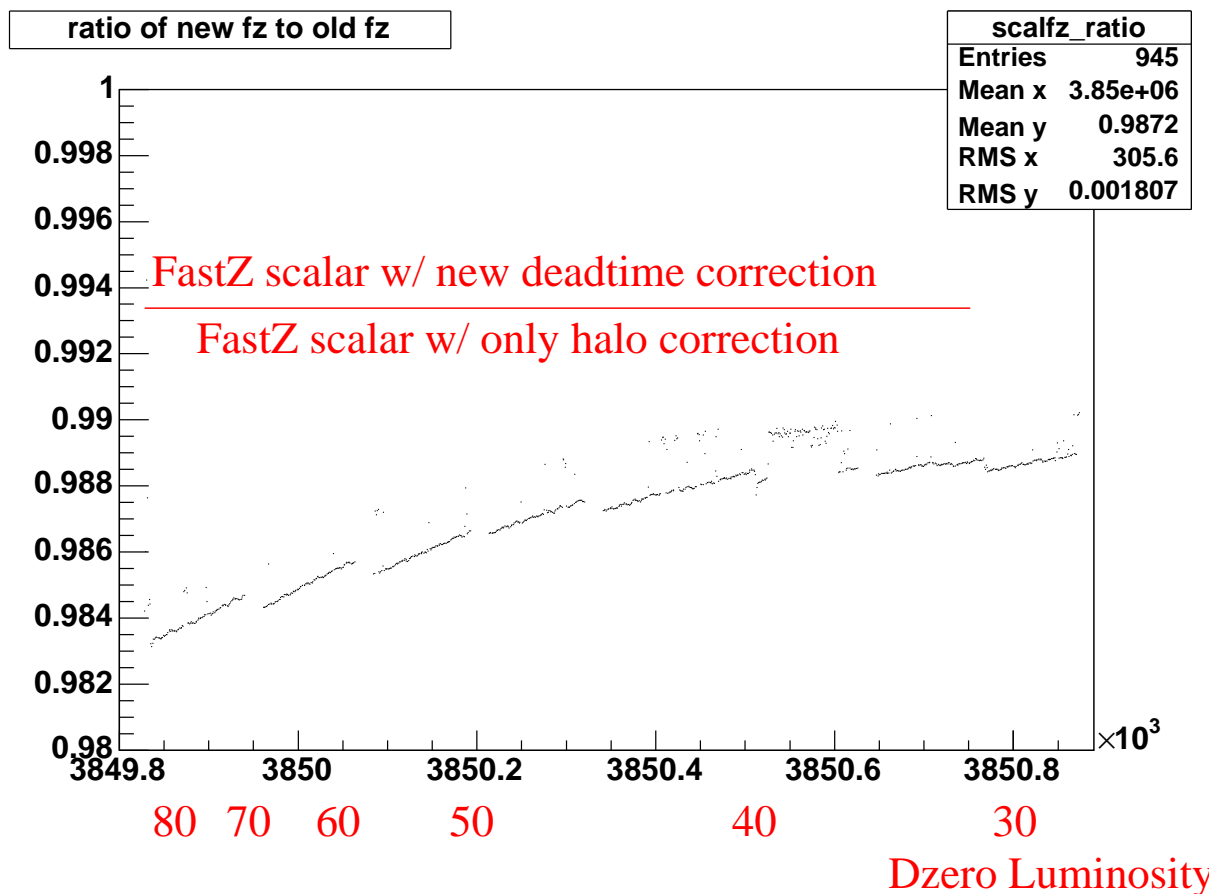
Jumps are prescale changes  $\Rightarrow$  readout noise component small.



# Deadtime Correction

crossings where the detector is off should not be counted in the denominator.

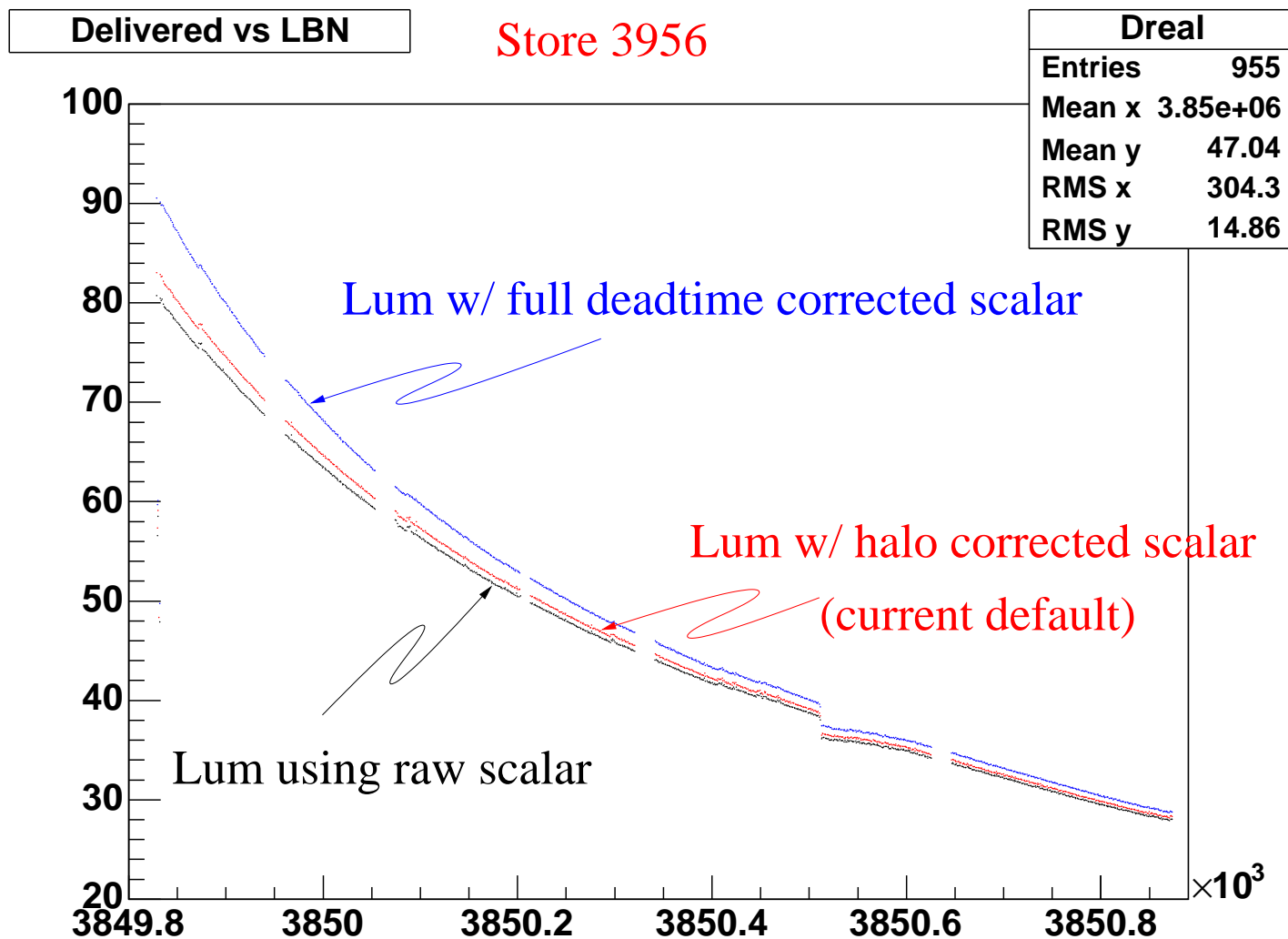
Store 3956



$$\frac{\Delta \text{FZ scalar}}{\Delta \text{ crossings}}_{\text{raw}} \Rightarrow \frac{\Delta \text{FZ scalar}}{\Delta \text{ crossings} - \Delta \text{p scalar} - \Delta \bar{\text{p scalar}}}_{\text{halo correction}} \Rightarrow \frac{\Delta \text{FZ scalar}}{\Delta \text{ crossings} - \Delta \text{ deadtime scalar}}_{\text{full deadtime correction}}$$



# Lum with Deadtime Correction





# Status

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- Working on understanding source of background that is causing the deadtime.
  - size of correction requires good understanding of background and could lead to possible ways to reduce background and reduce correction.
- Working to understand coupling of deadtime with baseline shifts
  - higher thresholds  $\Rightarrow$  less background; baseline shift  $\Rightarrow$  higher effective thresholds.
- redetermining absolute efficiency of detector to account for new magnetic field, new coupling scheme, new corrections.
  - using this as an opportunity to re-examine philosophy of the measurement and validity of assumptions.

Clearly too much work for the current luminosity group so significant human resources have been shifted to luminosity.